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ABSTRACT

The main emphasis of this investigation was to study the relationship of three cognitive styles (response tempo, response style and response ambiguity) of problem solving. A sample of 288 junior high school students participated in the study to ascertain the degree to which each cognitive style contributes to creative problem solving. The statistical results are included. (CK)

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Cognitive Style and Creative Problem Solving

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Perhaps the most persistent problem in creativity research has been the need to place creativity within the total perspective of the learning situation. One facet of this is the need to reduce the global consideration to more minor and manipulable relationships.

It is reasonable to view the creative process as a problem-solving process. As Northrop (1952) noted the creative process results from one being disturbed by a problematic situation. The creative process is distinct from convergent thinking. As Egan (1969) stated, "...convergent thinking is concerned with narrowing down the possibilities in the problem." or, as McGuire (1968) said, "...convergent thinking is the ability to give the appropriate response." Creative thinking does not follow prescribed paths to prescribed answers. To quote Cackowski (1969), "...creative thinking process, then, will have to be that thinking process which confronts a creative problem and succeeds in finding a solution without being supplied in advance with any algorithmical regulations." Cackowski further pursues, "The most important feature of any creative problem-solving process consists of breaking previous patterns of thinking."

The relatively consistent relationship of cognitive styles to problem solving is a challenging area in need of clarification. In recent years the notion of cognitive style has enjoyed considerable popularity largely because it promised an avenue for understanding how personality factors can influence perceiving, learning, thinking, and remembering. As such, cognitive styles are best represented as interacting dispositions within a person. These dispositions are a kind of bridge between personality and perceptual-cognitive variables. Accordingly, they affect the internal balance necessary for good quality on a problem-solving task.

In recent years three cognitive styles have generated interest. These are response tempo, response style, and response ambiguity. Each has demonstrated a relationship to certain types of problem solving. That is, the quality of the response depended largely on the type of cognitive style or strategy employed. Presumably this has consistently indicated that one or more of these cognitive styles accounted for those conditions within a problem solver necessary for success or failure. The main problem of this investigation, therefore, is to study the relationship of these cognitive styles to problem solving.

Response tempo was defined as the tendency to display slow or fast reaction times in problem situations with high response uncertainty. Essentially, response tempo is the predilection toward reflection or impulsivity. The scope of it is defined as a reflection-impulsivity dimension. In a sense a person develops a stable pattern or attitude toward problem solving and tends to utilize this as a problem-solving strategy. This cognitive style is especially

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influential in problems with alternative routes to solutions. Reflection upon the probable validity of varied solution sequences is critical for the ease with which success is achieved. The student who does not reflect on the differential validity of several solution possibilities is apt to offer the first idea that occurs to him.

The second cognitive style, response style, represents the stylistic tendency to use the extreme or moderate response categories on an intensity dimension. Those who possess the personal disposition to consistently respond in the extreme are said to have an extreme response style (ERS). Similar to impulsivity, this is an inappropriate response to stimuli in problem-solving tasks.

The third variable, response ambiguity, represents the tendency to be tolerant or intolerant of ambiguous stimuli. It is defined as a tolerance-intolerance of ambiguity dimension. This cognitive style is the construct of Frenkel-Brunswik (Adorno et. al., 1950). It was considered one of the basic variables of both an emotional and cognitive orientation of an individual towards life. Accordingly, it has a determining influence on many types of problem solving. Intolerance of ambiguity represents an excessive maintenance on a cognitive organization that yields biased or lowered scores. Necessary ingredients include a tendency to premature closure, a need to structure the environment even at the expense of neglecting reality, a tendency to precipitate early perceptual judgment, a propensity to think in rigid categories, and a frequent use of dichotomies.

Two of the cognitive styles of concern in the study, response ambiguity and response tempo, have been directly related to creative problem solving. Frenkel-Brunswik (1949) early linked tolerance of ambiguity with an openness in the cognitive, emotional, and social areas. Essentially, this was the capacity of existing amidst a state of affairs in which one does not comprehend all that is going on, but continues to affect resolutions despite the present lack of homestasis. This has received later support by Torrance (1962), Fleming and Weintraub (1962), and Stern (1967).

The relationship of response tempo with creative problem solving has been more equivocal than that of response ambiguity. Barron (1953, 1955, 1963a, 1963b) and Guilford (Christensen et. al., 1957) using different scales found both tolerance of ambiguity and impulsivity related to creativity. In contrast, a further series of studies have demonstrated support only for tolerance of ambiguity. Long and Henderson (1964) using the Torrance test battery found that the more reflective style relating to tolerating ambiguity, of withholding opinions when information is lacking, and resisting premature closure is indicative of creative problem solving. Additional support for this has come from studies using projective tests (Weisberg and Springer, 1961), open-ended questionnaires (Torrance and Dauw, 1965), as well as summary articles (Golann, 1963).

There is a readily apparent need for clarification of the relationship of creativity to the three cognitive styles. The cognitive styles of response ambiguity and response tempo have in one way or another been related to creativity. While response style has received little or no empirical concern, it appears to have at least a conceptual relationship. Therefore, this study attempted to ascertain the degree to which each contributes to creative problem solving.

The sample consisted of 288 grade 7 and 8 junior high school students. There were 145 girls and 143 boys ranging in age from 131 months to 190 months. The means of the intelligence quotients, based on the Otis-Lennon Mental Ability Test were 107.9 and 102.2 respectively. The students were mostly from rural, middle-class families.

To assess response tempo, the Sutton-Smith, Rosenberg Impulsivity Scale for children as modified by Hirschfield was used. For response style, the Perceptual Reaction Test was employed. The Modified Revised California Inventory was employed to measure response ambiguity.

To assess student creativity, two measures were employed. The Minnesota Tests of Creative Thinking (MTCT), Verbal Form A and the Pennsylvania Assessment of Creative Tendency (PACT), Form 39 were used. The MTCT attempts to assess the products of creative thinking in terms of Guilford's divergent thinking factors (fluency, flexibility, originality, and elaboration). PACT is a measure of the student's tendency to respond creatively to problematic events. The MTCT was scored for fluency, flexibility, and originality as well as a composite score calculated according to the method suggested by Torrance (1966).

A matrix of zero-order correlation coefficients composed of intelligence (IQ), response ambiguity (RA), response tempo (RT), response style (RS), PACT and the MTCT is given in Table I. Upon inspection of this table it can be seen that response ambiguity related significantly to both creativity measures. Response tempo related significantly but negatively to PACT and not at all to the MTCT. Response style did not relate significantly to either measure of creativity.

It is worth noting that intelligence related to both measures of creativity at about the same level.

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insert Table I

As can be seen in Table I, the correlation among the three components of the MTCT is rather high which raises theoretical concern. The high correlation contraindicated the central rationale of creativity as held by Torrance; that these components are relatively distinct, representing "miniature models" of the total creative act (Torrance, 1966).

A series of multiple regression analyses were calculated with creativity measures as the dependent variable(s). The multiple R for the MTCT range from .280 (fluency) to .344 (flexibility). The multiple R for PACT was .461. The results are given in Table II.

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insert Table II

An inspection of Table II reveals that, while in all of the criterion variables, fluency (5), flexibility (6), originality (7), and creative problem solving (8), the proportion of variance explained (R^2) fluctuates, the predictor variables explain only a small portion of the total variance of creativity (e.g., less than 12 per cent - ,1146 - is explained for creative problem solving). The variance of PACT (9), the experimental test, is more substantially explained, 21 per cent. It appears on the basis of the previous research that this amount of explained variance of the MTCT is not unusual. Few variables substantially contribute to creativity.

A further inspection of Table II reveals the Beta weights for each of the predictor variables. It is evident that response ambiguity accounts for the majority of the explained variance with response tempo minimally contributing and response style ineffective. On the basis of the previous research these results are comprehensible, since response ambiguity has consistently weighted on creativity, response tempo sporadically, and response style appears devoid of any relationship.

The results of the F test showing that predictor combination not significantly different than any higher order predictor combination are given in Table III. From these more "refined" combinations it becomes evident that response ambiguity is again the best predictor. The higher weighting of this variable on flexibility (.3621), originality, and creative problem solving (.3573) than on fluency (.2873) seem to be due to this cognitive style's emphasis on response merit as opposed to quantity. Response ambiguity apparently is more highly associated with response quality.

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insert Table III

As a result of the significant correlations of IQ to creativity reported in Table I, multiple regression analyses incorporating intelligence were performed. In Table IV, the values of R, R^2, and the beta weights are reported. The F ratio compares two regression equations to discover if the longer equation explains a significantly greater amount of variance of the dependent variable.

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insert Table IV

As can be seen, not only is there more variance being explained (R^2) by the addition of intelligence over the previous hypothesis, where it was not a competing variable, but its relative influence (beta weight) on the various forms of creativity is rather substantial.

The key question of this hypothesis is whether the cognitive styles add significantly to the contribution of intelligence or are of practical value. Table V gives the results of whether the inclusion of the cognitive styles in the regression equation tends to reduce the error of estimate significantly leading

to an increase in R. Using creativity in all its forms as the criterion variable, there is significance in each case. But the differences between the two equations are small. This appears due to the somewhat unexpected influence of intelligence resulting in the lessened contributions of the cognitive styles.

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insert Table V

It seems that the most fruitful approach in obtaining information about these two constructs, cognitive styles and intelligence, is to view their proportional contributions when only the best set of predictor variables is considered. In this case intelligence and response ambiguity each contribute to the explained variance of creative problem solving and its components, with IQ being more influential on those creativity components emphasizing response quality, particularly originality (7). It is important to note that response ambiguity does substantially account for the variance of PACT. The results are given in Table VI.

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insert Table VI

Intelligence and the cognitive styles appear to contribute equally to the explained variance of creativity. The cognitive styles of response ambiguity, in particular, and response tempo significantly contribute to creative problem solving and its components independent of intelligence. When intelligence is introduced, this, along with response ambiguity, explain most of the variance, with IQ more heavily weighted on the quality response items. Response ambiguity in both cases appears to be a good predictor of PACT. In this study creativity is about equally affected by intelligence and the cognitive styles. At the least, the relationship of the cognitive styles to creativity seems to possess theoretical merit.

It should be noted that these results support the previous research findings of Wallach and Kogan (1965), among others. That is, on the basis of the present findings it is evident that verbal creativity fails to assess a unified domain of cognitive functioning that is wholly distinct from intelligence. Much variance, however, is unexplained.

Table I

Product Moment Correlation Coefficients Among Variables

	2	3	4	5	6	7	8	9
1. IQ	.534*	-.204*	-.225*	.230*	.362*	.381*	.355*	.360*
2. RA		-.323*	-.212*	.247*	.321*	.295*	.316*	.448*
3. RT			.158*	.032	.010	-.015	.011	-.216*
4. RS				.017	-.090	-.020	-.037	-.017
5. FLUENCY					.741*	.829*	.930*	.218*
6. FLEXIBILITY						.702*	.905*	.212*
7. ORIGINALITY							.910*	.287*
8. MTCT COMPOSITE								.259*
9. PACT								

* Significant beyond .01 level

Table II

Multiple R, R^2 and Beta Weights of the Cognitive Styles for Creativity

Combination	Multiple R and R^2		Beta Weights		
	R	R^2	RA(2)	RT(3)	RS(4)
$R_{5.234}$	.280	.078	.2984	.1192	.0616
$R_{6.234}$	.344	.118	.3558	.1311	.0351
$R_{7.234}$	.309	.095	.3315	.0862	.0314
$R_{8.234}$	.339	.115	.3608	.1245	.0194
$R_{9.234}$	.461	.212	.4301	-.0953	.0678

NOTE: Variables 5 (fluency), 6 (flexibility), 7 (originality), 8 (creative problem solving), and 9 (PACT), are creativity factors and not related to MTCT composite.

Table III

F Value, Multiple R, R^2, and Beta Weights for the Best Combination of Cognitive Styles for Creativity

Best Combination	F Value	R	R^2	Beta Weights RA(2)	Beta Weights RT(3)
$R_{5.23}$	4.33*	.274**	.075	.2873**	.1254
$R_{6.23}$	4.70*	.342**	.117	.3621**	.1276
$R_{7.2}$	27.34**	.295**	.087		
$R_{8.23}$	4.6*	.338**	.114	.3573**	.1264
$R_{9.2}$	65.32**	.448**	.201		

* Significant beyond .05 level
** Significant beyond .01 level

Table IV

Multiple R, R^2, and Beta Weights of the Cgonitive Styles and Intelligence for Creativity

Combination	Multiple R and R^2		Beta Weights			
	R	R^2	IQ(1)	RA(2)	RT(3)	RS(4)
$R_{5.1234}$	.309	.095	.1546	.2207	.1229	.0793
$R_{6.1234}$	.413	.170	.2727	.2195	.1372	
$R_{7.1234}$	.414	.171	.3283	.1665	.0940	.0747
$R_{8.1234}$	.409	.167	.2742	.2229	.1242	.0508
$R_{9.1234}$	.489	.239	.1907	.3421	-.0876	.0872

Table V

Multiple Correlation Coefficients of Intelligence and Intelligence Plus Cognitive Styles in Predicting Creativity

Criterion	Intelligence	Intelligence Plus Cognitive Styles	F Value
Fluency (5)	.230	.309	4.41**
Flexibility (6)	.362	.413	4.49**
Originality (7)	.381	.414	2.97*
MTCT Composite (8)	.355	.409	4.67**
PACT (9)	.360	.489	13.60**

Table VI

F Value, Multiple R, R^2, and Beta Weights for Best Combination of Cognitive Style and Intelligence for Creativity

Best Combination	F Value	R	R^2	IQ(1)	RA(2)	RT(3)
$R_{5.123}$	4.53*	.299	.089	.1426	.2127**	.1304
$R_{6.123}$	5.75*	.413	.170	.2727**	.2195**	.1372*
$R_{7.12}$	3.99*	.396	.157	.3124**	.1286	
$R_{8.123}$	5.60*	.406	.165	.2666**	.2178**	.1358
$R_{9.12}$	8.62**	.476	.226	.1842**	.3577**	

* Significant beyond .05 level
** Significant beyond .01 level

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